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may be urged that, in America, he has not done full justice to the work of the independent telephone companies and their inventors. The great bulk of the development in this country is undoubtedly due to the Bell organization, its pioneers, inventors, organizers, engineers and constructors; yet a very appreciable residual share is due to the competing independent companies. It must be remembered, however, that the author has not had the same opportunity to become acquainted with ultra-Bell sources in America, that he has in Great Britain, but there he has given credit with an impartial pen.

The chapter on the telephone and governments should be studied by those who, as outsiders in telephony, seek to form a just estimate of the relative advantages of governmental versus private-corporation administration. The author knows whereof he speaks, for he has been in intimate touch with telephony in England, both under company operation, and under government operation. He also writes in a fair and open-minded vein. The conclusion which is apparently unavoidable is that governments are not able to operate a country's telephone system so efficiently, economically or progressively as a private corporation under government control. For this conclusion, there is certainly abundant evidence. In Europe, where the governments almost invariably operate the systems, the only country in which it appears that the telephones are in private hands, is Denmark. Denmark is accorded 4.5 telephones per hundred of population; whereas the highest use in any government-operated country is 2.1 (for the German Empire). In the United States, the number given is 9.7 per hundred, or more than double Denmark's.

The book is almost the only history of its kind, and is a welcome addition to the literature of telephonic growth and development.

A. E. KENNELLY

An Introduction to the Principles of Physical Chemistry. By EDWARD W. WASHBURN. New York, McGraw-Hill Book Co., Inc., 1915. Pp. xxv + 445.

This volume constitutes a marked departure from the conventional method of treatment which most authors have followed under the influence of the early spirit of physical chemistry which found concrete expression in Ostwald's "*Lehrbuch der allgemeinen Chemie*." Many years have elapsed since this epoch-making work appeared and many important contributions have been made to our knowledge of the subject in the meantime. The controversies, however, which arose in the early development of physical chemistry, have been so prolonged that most writers have confined themselves to the outline of the subject as established by precedent and have found little opportunity to lay before the student the more recent developments in this field. In this respect the present volume is a welcome addition to the literature. The treatment of the subject is distinctly along original lines.

The book is well written, and the subject-matter is presented in a manner which retains the interest of the reader. A large number of very excellent figures are given, many of them being original. The numerous problems appearing throughout the text are well selected. The biographical references will prove of interest to the student. A later edition should give reference, however, to Mayer, Joule and Helmholtz, in connection with the first law of thermodynamics. The reference to J. Willard Gibbs as "one of America's greatest chemists," fails to recognize the importance of Gibbs's work along other lines than those of chemistry. References to the literature are numerous and add greatly to the value of the text. Cross references are frequent, but references to page and section would be more convenient than references to chapter and section. Misprints and other minor defects are much less common than is usual in first editions.

The division of the subject-matter is excellent, on the whole, but it is to be noted that the greater portion of electrochemistry is omitted. Gaseous equilibria, in fact, equilibria in general, with the exception of electrolytic equilibria, are treated very briefly. The Nernst heat theorem is not mentioned, al-

though specific heats are discussed at some length.

Nearly all of the important physical chemical relationships are expressed in mathematical form. The derivation of those relationships which are based on thermodynamic principles is given in an appendix. The differential equations are obtained by means of an ingenious device termed a "Perfect Thermodynamic Engine," which appears to be a modification or rather an amplification of the familiar cyclic process. This method of treatment should be of great service to those students who lack the analytical turn of mind.

As stated in his preface, the author has made a radical departure from the classical treatment of the second law of thermodynamics. He has attempted to formulate this law in mathematical form by means of elementary kinetic considerations. The Carnot cycle has been entirely omitted. The wisdom of this procedure may be questioned, for the method involving Carnot's cycle is both simple and instructive. It brings out, moreover, the important fact that the second law is a principle of that general character which is not dependent upon the mechanism involved in a given process, and that conversely it can give us no information as to the character of the mechanism involved therein. The necessity of supplementing thermodynamics with results obtained from the kinetic hypothesis is thus almost self-evident, but it is well to avoid leading the student to infer that simplicity is one of the chief virtues of the statistical method. The author's argument on pages 104 and 105 is not over clear. The two processes there described are not identical as to initial and final conditions, nor is it apparent how these two processes are related to each other. The treatment given tends to confuse the work of a Carnot's cycle with the second law of thermodynamics, while it does not clearly point out that the second law involves an inequality, not an equality. The entropy function, which is of fundamental importance in the treatment of the second law, is nowhere mentioned, nor is the Helmholtz equation formulated.

The subject of solutions is treated at length and from a much more general point of view than is commonly the case. Electrolytic solutions, so far as aqueous solutions are concerned, are fully treated. An excellent discussion is given of equilibria involving the ions of water, including hydrolytic and indicator reactions.

In treating the phase rule the author introduces the composition number, which is the mol-fractions of the smallest number of molecular species present in a given phase which must be specified in order to fix the composition of the phase in question. The composition number of a system is defined as "equal to the largest composition number of any of the phases of the system." The last definition leads to a certain restriction of the phase rule which is avoided in the usual method of treatment. This becomes clear in the case of a two component system in which the three phases present in equilibrium are all pure substances, as, for example, in the system, CaCO_3 , CaO , CO_2 . The author's definition leads to the necessity of considering that one of the phases contains all of the substances in question, for example, that the vapor phase contains CaCO_3 and CaO as well as CO_2 .

In the discussion of the composition-temperature diagram of solid solutions (p. 356), the author has failed to give the interpretation of the field lying between the curves for the solid and liquid solutions. A few other minor corrections may be noted. The definition of the viscosity coefficient (p. 51) is in error; the maximum work is not clearly distinguished from the free energy (p. 110); the terms "divariant" and "binary," "trivariant" and "ternary," etc., are confused with each other (p. 342).

The book comprises 27 chapters and an appendix, and covers the entire field with the exceptions noted above. It is only in exceptional instances that anything but the most favorable criticism can be made. The author has made an important contribution to the list of texts available for the use of students. The volume should find its way generally into the chemist's library. In the hands of a compe-

tent instructor it should prove an admirable text for classroom use.

CHARLES A. KRAUS

CLARK UNIVERSITY,
March, 1916

Being Well-Born: An Introduction to Eugenics. By MICHAEL F. GUYER, Ph.D. Indianapolis, The Bobbs-Merrill Co., 1916. 374 pages. \$1.00.

This is one of the later volumes in the extensive "Childhood and Youth Series" edited by M. V. O'Shea. The general purpose of this series is "to give to parents, teachers, social workers and all others interested in the care and training of the young, the best modern knowledge about children in a manner easily understood and thoroughly interesting." The special purpose of this volume is "to examine into the natural endowment of the child" and to give "an account of the new science of eugenics." There is some reason for thinking that the value of Professor Guyer's work would not have been lessened, had he been entirely freed from the special purposes and influences of the "Series." As it stands, however, the work has very distinct merit and a high degree of usefulness.

In its general plan the book does not differ materially from other "Introductions" to the hybrid science of eugenics, although certain phases are treated with more than the usual detail. The work may be divided into three parts. The first, including the first four chapters, deals with the subject of heredity, its definition, cytological basis and Mendelian descriptions. This is the clearest cut and most authoritative section, well adapted for the student class. The reviewer's experience, however, leads him to believe that the average reader of the class for whom it is intended, will find even these clear descriptions too difficult really to be comprehended without the added services of an experienced guide. The glossary which is appended will aid in assisting the uninitiated over the difficult spots. The attempt to explain the inheritance of sex and of sex-linked characters, before the principles of Mendelism have been discussed is unusual. It is of interest to note that, wisely,

only four pages are given to the statistical descriptions of heredity, and that the author takes a conservative position regarding the Mendelian interpretation of some of the data from the Eugenics Record Office.

The second group of four chapters sets forth some of the implications of the facts described in the first section, as they are related to the characteristics of the individual. Two long chapters entitled "Are Modifications Acquired Directly by the Body Inherited" and "Prenatal Influences" are certain to be of very great value to the general reader. The materials are well considered, lucidly presented and a clear distinction made between the scientific and the superstitious conceptions of prenatal influence. This is a subject upon which popular ideas seem hopelessly confused and Professor Guyer has done well to devote so much space to their consideration. The chapter on "Responsibility for Conduct" is less direct and logical, leaving the reader in some doubt as to whether the author's conclusion that "All normal men are responsible for their conduct" is the only one that could be drawn from the evidence given. This is the least satisfactory chapter in the book.

The last section consists of two chapters dealing with the social implications of the facts of heredity. There are very clear and pointed summaries of what is known and of what is believed in this field. The eutheic aspects of the problem are stated and fully credited and the whole discussion is well tempered and sane. Finally the familiar remedies for correcting the antisocial and degenerative process now going forward at so rapid a pace, are discussed. Marriage restrictions and mating systems are recognized as of relatively little practicality; segregation is regarded as hopeful though costly; sterilization as still on trial. Public education and the ensurance of environments that will call forth right reactions seem to offer, for the present, the most hopeful elements in the eugenic program.

The book is well got up, unusually free from errors and the price remarkably low, all of which will add to its well-deserved usefulness and influence.

WM. E. KELLCOTT